

WHAT IS CLAIMED IS:

- 1 1. Apparatus for removing particles from a surface of an article to be cleaned,  
2 said apparatus comprising:  
3 a pump; and  
4 a first tube or slot connected at one end to said pump so as to create a flow  
5 of a first gas in said first tube or slot, and having the other end substantially facing  
6 said surface;  
7 wherein a juxtaposition of said first end and said surface, together with  
8 said flow of said first gas in said first tube or slot, forms a shock wave sufficient to  
9 dislodge said particles from said surface of said article.
- 1 2. An apparatus as claimed in claim 1, wherein said flow of said first gas in  
2 said first tube or slot results from a pressure differential between an inside of said  
3 first tube or slot, and an outside of said first tube or slot.
- 1 3. An apparatus as claimed in claim 2, wherein said pressure differential is  
2 such that a pressure in said first tube or slot is less than a pressure outside of said  
3 first tube or slot.
- 1 4. An apparatus as claimed in claim 3, wherein said pump is a vacuum pump.
- 1 5. An apparatus as claimed in claim 2, wherein said pressure differential is  
2 such that a pressure in said first tube or slot is greater than a pressure outside of  
3 said first tube or slot.
- 1 6. An apparatus as claimed in claim 5, wherein said pump pumps gas into  
2 said first tube or slot.
- 1 7. An apparatus as claimed in claim 1, further comprising means for effecting  
2 relative movement between said first tube or slot and said surface.
- 1 8. An apparatus as claimed in claim 7, wherein said means for effecting  
2 relative movement comprises means for moving said first tube or slot across said  
3 surface in raster fashion.
- 1 9. An apparatus as claimed in claim 7, wherein said means for effecting  
2 relative movement comprises means for rotating said article, and means for

3 passing said first tube or slot between a center of said article and a perimeter of  
4 said article.

1 10. An apparatus as claimed in claim 7, wherein said means for effecting  
2 relative movement causes relative movement between one or more particular areas  
3 of said surface, and said first tube or slot.

1 11. An apparatus as claimed in claim 10, whereby one or more particular areas  
2 of said surface are cleaned to a greater extent than other areas of said surface.

1 12. An apparatus as claimed in claim 1, wherein a tip of said other end of said  
2 first tube or slot has one of a half-conical shape, a truncated half-conical shape, a  
3 conical shape, or a rounded shape.

1 13. An apparatus as claimed in claim 1, wherein said other end of said first  
2 tube or slot is disposed so as to form a predetermined gap between said surface  
3 and said first tube or slot, said shock wave being formed in said gap.

1 14. An apparatus as claimed in claim 1, further comprising a further tube or  
2 slot, concentric with and inside said first tube or slot, for providing a flow of a  
3 second gas toward said surface of said article, said shock wave being formed by  
4 flow of said second gas in said first tube or slot.

1 15. An apparatus as claimed in claim 14, wherein said second gas is the same  
2 as said first gas.

1 16. An apparatus as claimed in claim 14, wherein a vacuum is formed in said  
2 further tube or slot.

1 17. An apparatus as claimed in claim 1, further comprising a plurality of said  
2 tubes or slots, each having a respective end substantially facing said surface, and  
3 each of said tubes or slots having a pressure within that is sufficiently different  
4 from a pressure without to form a shock wave at said respective end.

1 18. An apparatus as claimed in claim 1, further comprising a further tube or  
2 slot juxtaposed with respect to an opposite surface of said article from said first  
3 tube or slot so as to effect cleaning of said surface and said opposite surface.

1 19. An apparatus as claimed in claim 1, wherein said article is a  
2 semiconductor wafer.

1 20. An apparatus as claimed in claim 1, wherein said article is a reticle.

1 21. A method of removing particles from a surface of an article to be cleaned,  
2 said method comprising providing a first tube or slot with one end connected to a  
3 pump and the other end disposed substantially facing said surface, and providing a  
4 flow of a first gas in said first tube or slot so as to induce a pressure differential  
5 between an inside of said first tube or slot, and an outside of said first tube or slot,  
6 said pressure differential forming a shock wave sufficient to dislodge said  
7 particles from said surface.

1 22. A method as claimed in claim 21, wherein providing said flow of said first  
2 gas comprises reducing a pressure in said first tube or slot with respect to a  
3 pressure outside of said first tube or slot.

1 23. A method as claimed in claim 21, wherein providing said flow of said first  
2 gas comprises increasing a pressure in said first tube or slot with respect to a  
3 pressure outside of said first tube or slot.

1 24. A method as claimed in claim 21, further comprising effecting relative  
2 movement between said first tube or slot and said surface.

1 25. A method as claimed in claim 24, wherein said effecting relative  
2 movement comprises moving said first tube or slot across said surface in raster  
3 fashion.

1 26. A method as claimed in claim 24, wherein said effecting relative  
2 movement comprises rotating said article, and passing said first tube or slot  
3 between a center of said article and an external perimeter of said article.

1 27. A method as claimed in claim 24, wherein said effecting relative  
2 movement causes relative movement between one or more particular areas of said  
3 surface, and said tube or slot.

1 28. A method as claimed in claim 27, whereby one or more particular areas of  
2 said surface are cleaned to a greater extent than other areas of said surface.

1 29. A method as claimed in claim 21, wherein said providing said first tube or  
2 slot comprises disposing said other end so as to form a predetermined gap

3 between said surface and said first tube or slot, said shock wave being formed in  
4 said gap.

1 30. A method as claimed in claim 21, further comprising providing a further  
2 tube or slot, concentric with and inside said first tube or slot, for providing a flow  
3 of a second gas within said further tube or slot, said shock wave being formed by  
4 flow of said second gas in said first tube or slot.

1 31. A method as claimed in claim 30, wherein said second gas is the same as  
2 said first gas.

1 32. A method as claimed in claim 30, further comprising forming a vacuum in  
2 said further tube or slot.

1 33. A method as claimed in claim 21, further comprising providing a plurality  
2 of said tubes or slots, each of said tubes or slots having a respective end  
3 substantially facing said surface, each of said tubes or slots having a pressure  
4 within that is sufficiently different from a pressure without to form a shock wave  
5 at said respective end.

1 34. A method as claimed in claim 21, further comprising providing a further  
2 tube or slot juxtaposed with respect to an opposite surface of said article from said  
3 first tube or slot so as to effect cleaning of said surface and said opposite surface.

1 35. A method as claimed in claim 21, wherein said article is a semiconductor  
2 wafer.

1 36. A method as claimed in claim 21, wherein said article is a reticle.